Biologically Inspired Computing

EECS 6180

Homework 6

Neural Evolution

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Introduction

A 4 layer NN and 5 layer NN were evolved to compare to the *Iris_bp* algorithm. The programs for all algorithms are provided in the appendix. Figure 1 is a sample NN with only 3 hidden neurons. Figure 2 and 3 represent a sample chromosome corresponding to the 4 and 5 hidden neuron evolutionary NN's designed for this project.

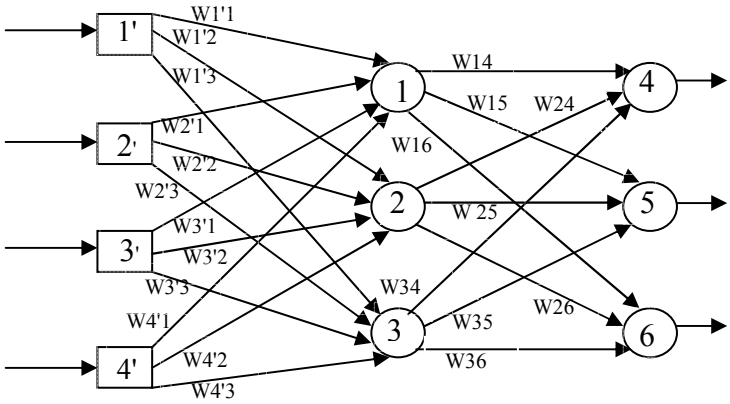

Fig. 1: Sample Neural network Architecture for Iris Data Set

W1'1	W1'2	W1'3	W1'4	W2'1	W2'2	W2'3	W2'4	W3'1	W3'2	W3'3	W3'4	W4'1	W4'2	W4'3	W4'4	W15	W16	W17	W25	W26	W27	W35	W36	W37	W45	W46	W47	T1	T2	T3	T4	T5	T6	T7

Fig. 2: Chromosome 4 hidden neuron NN

W1'1	W1'2	W1'3	W1'4	W1'5	W2'1	W2'2	W2'3	W2'4	W2'5	W3'1	W3'2	W3'3	W3'4	W3'5	W4'1	W4'2	W4'3	W4'4	W4'5	W16	W17	W18	W26	W27	W28	W36	W37	W38	W46	W47	W48	W56	W57	W58	T1	T2	T3	T4	T5	T6	T7	T8

Fig. 3: Chromosome 4 hidden neuron NN

Technique

1. Training

In each case a set of 100 weight matrices were generated for Evolutionary training. This was done with:

```
W=rand(100, 35); for 4 hidden Neurons
W=rand(100, 43); for 5 hidden Neurons
```

The training and testing data were randomly selected from *Iris_data.* The training algorithm was a for loop which used a feed forward technique with a sigmoid function. The error for each input and subsequent set of weights (individual chromosome) was used to select the top 40 weight chromosomes.

2. Crossover

The top 40 weight chromosomes were crossed such that only weights corresponding to hidden1, hidden2…, hidden5, out1, out2, and out3 crossed with one another and genes from hidden1 did not cross with any other neuron's genes.

3. Mutation

The top 60 weight chromosomes were used for mutation and each individual gene had a probability of mutation = 0.1%

After each training generation if the mse of the training output was less than 0.07 then training would stop.

4. Testing

After either the training had run out of training samples or the training criteria was met then the testing was done in the same fashion only using the best weight chromosome determined from training.

Results

			Testing Error		
Method	Training time (s)	Epochs generations	%Error Iris-setosa	%Error Iris-versicolor	%Error Iris-verginica
Iris_bp	6.1347	1000	0%	10%	0%
Evo NN 4hidden	6.65	100	40%	100%	100%
Evo NN 5hidden	6.45	99	6.25%	0%	100%

Conclusion

The results show that there is more time needed to develop a good working Evolutionary Neural Network, but it is possible to obtain a better performance with respect to time.